Advancing Analysis, Forecast and Warning Capabilities for High Impact Weather Events

Project Areas Being Addressed:

(1) Warn on Forecast for High Impact Events
(2) Integrated Observing and Analysis System

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Reporting Period: November 1, 2013– April 30, 2014

Introduction

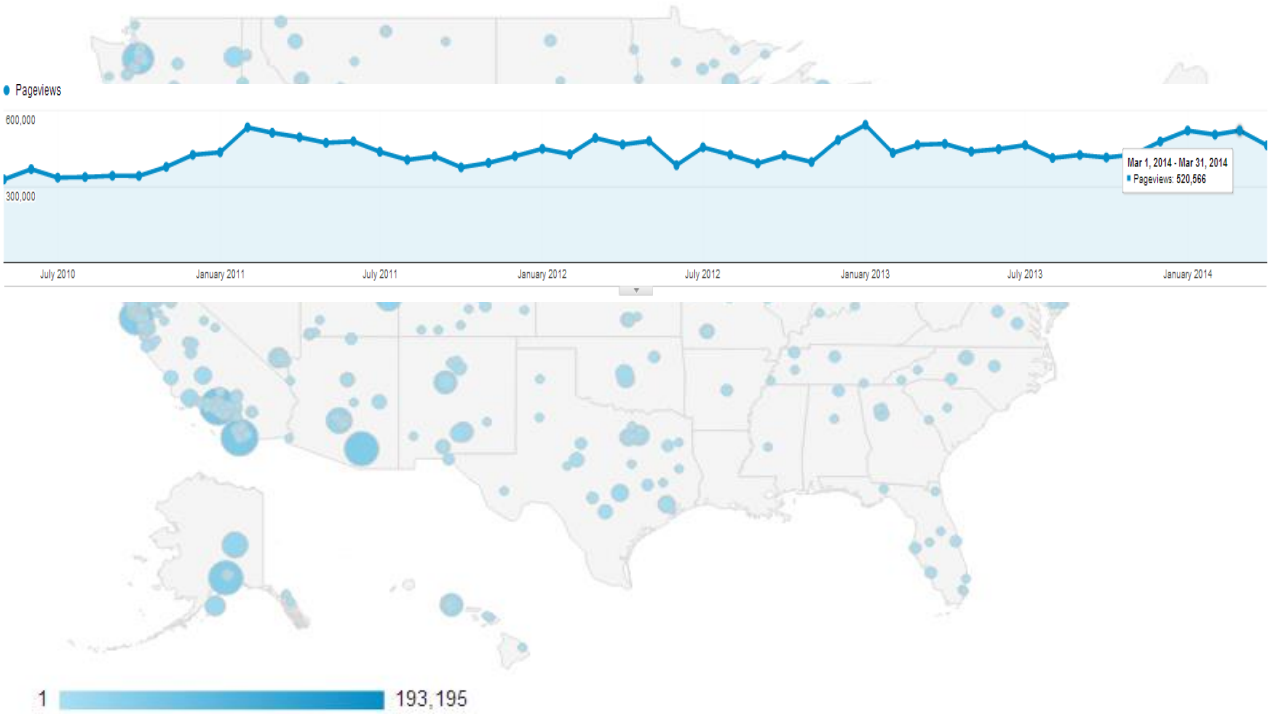
This summarizes the final six months of this project and begins to pull together information for the entire project. During the entire project, considerable progress has been made towards analyzing and forecasting high-impact weather events over complex terrain. The specific goals for this project continued to be: (1) improve the identification and prediction of high impact weather events through the continued development of data mining software using MesoWest; (2) improve four dimensional analysis systems through research and development on their sensitivity to boundary layer data asssets, quality control procedures, and characteristics of the analysis systems in complex terrain; and (3) advance short-to-medium range forecast capabilities for high-impact weather events over the western United States.

We describe our efforts in each of these three areas herein.

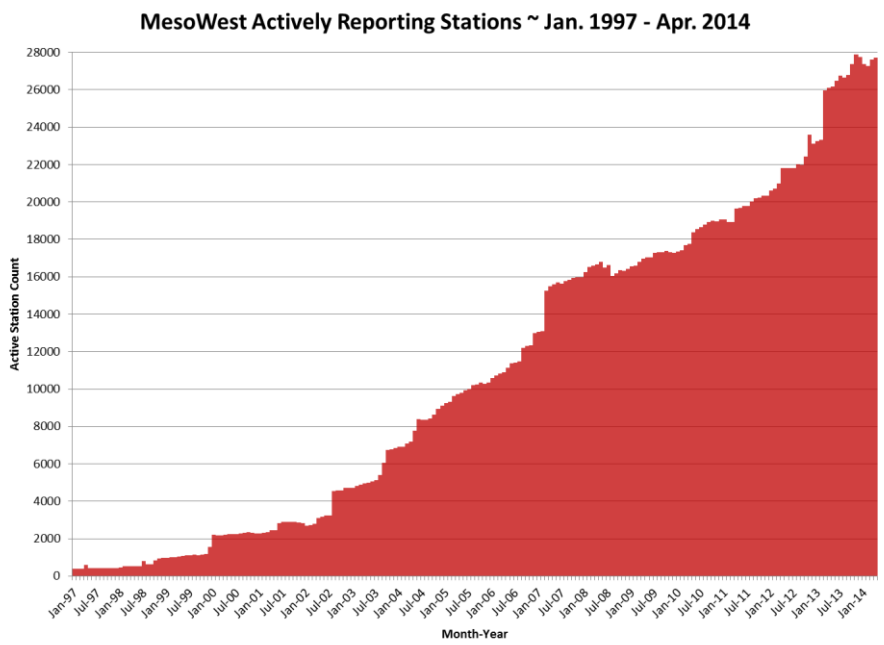
1. Identification and prediction of high impact weather events- Utilization of MesoWest

Monitoring of users via Google Analytics during the period May 1 2010 – April 30, 2014 indicates that 870,021 visitors accessed over 20 million pages of weather information. Users on average spent 27 min viewing information on MesoWest. These are extremely conservative

estimates of MesoWest usage, since these statistics are from the University of Utah web site only and do not include access via NWS web pages that rely on MesoWest. The cities from which we receive the most requests reflect the impact of MesoWest nationwide, but it is also possible to see the heightened use from cities that contain NWS WFOs in the west and around the nation



during this period. As shown below, high usage in terms of pages viewed is continual throughout the period.



We have continued to support access to weather observations from ~28,000 stations received in near-real time. We have added many new networks and additional stations from existing networks during the project in coordination with the MADIS/ESRL staff and a number of WFO offices around the country. The increase over the past four years of roughly 10,000 stations is notewrthy. These increases can be monitored via the web page: http://mesowest.utah.edu/cgi-bin/droman/plot_station_activity.cgi. The contributions of ~7000 stations now from MesoWest to MADIS and thereby the utilization of mesonet observations in NWS operations is compelling.

We continued our efforts during this period to manage parallel data bases at NWS Western Region, the University of Utah, and on cloud servers. We continued to implement a number of new programs to manage metadata and to summarize that information for NWS and other users. The no-cost extension is providing the time to continue to transition some of our collection, archiving, and dissemination of the data to these cloud servers.

2. Improved Analysis Systems

We have continued to develop our variational analysis code in Python. This work follows from Horel and Tyndall (2013). As part of the Sandy Supplemental uprgrades underway, including the development of the NCEP Unrestricted Mesoscale Analysis, a presentation to NWS and NOAA personnel about the UU2DVAR was made on October 20, 2013 and collaboration has continued regarding quality control and utilization of surface observations.

Python is an open source computing language that has many advantages for IO and graphics. The UU2DVAR code is now optimized to complete a national scale surface analysis in 13 minutes using 8 processors on a local workstation. The UU2DVAR is an efficient 2D variational system functionally equivalent to the NCEP Real Time Mesoscale analysis (RTMA). We are implementing the UU2DVAR system primarily as a quality control tool for publicly-accessible surface observations. The analysis system uses the 2.5 km resolution background fields used by the RTMA and ~15000 observations available each hour from many different mesonets are then used to modify the background grids and obtain hourly analyses.

A necessary step to integrate existing and future networks into a national network of networks is to assess the impact of existing mesonets. We are now generating statistics each hour that allows us to monitor the impact of observations of temperature, wind, and moisture.

3. Advancing Short-to-Medium Range Forecasts of High-Impact Weather Events

A number of presentations related to MesoWest were presented at the 2014 Annual AMS

meeting.

Jon Rutz continued his work on the inland penetration of atmospheric rivers using a Lagrangian (trajectory) approach. This work seeks to better quantify the differences between atmospheric rivers that penetrate or don't penetrate into the interior western United States. It is anticipated that this work will be completed during the first year of our new C-STAR award. Training activities related to this work include presentations for NOAA/ESRL, the Pacific Northwest Weather Workshop, and the Great Divide Workshop.

We continue to collaborate with Trevor Alcott and WR-SSD to eavluate techniques to anticipate atmospheric river related precipitation over the western U.S. (e.g., the use of precipitable water and integrated vapor transport standardized anomaly and return interval in the NAEFS situational awareness table at http://ssd.wrh.noaa.gov/satable/). We have also initiated an effort, to be completed during the next C-STAR award, to validate and improve precipitation downscaling techniques based on ensemble forecast systems.

SCEP student Jon Rutz, Chris Gibson (SOO-Missoula), and Dave Bernhardt (SOO-Great Falls) continue to work to integrate the Candian-developed METRo road model into NWS operations. A paper based on this work was recently published in the Bulletin of the American Meteorlogical Society (Rutz and Gibson 2013).

<u>Publications and NWS Related Training activities</u> <u>Nov-Apr 2014</u>

We have continued to interact extensively with WFO and national centers staff through conference calls, site visits, webinars, regional workshops and COMET-related training. Status of publications relevant to the operational communicty within this reporting period follows.

Campbell, L. S., and W. J. Steenburgh, 2014: Fine-scale orographic precipitation variability and gap-filling radar potential in Little Cottonwood Canyon, Utah. *Wea. Forecasting*, in press.

Massey, J. D., W. J. Steenburgh, S. W. Hoch, and J. C. Knievel, 2014: Sensitivity of near-surface temperature forecasts to soil properties over a sparsely vegetated dryland region. *J. Appl. Metor. Clim.*, in press.

Rutz, J. J., W. J. Steenburgh, and F. M. Ralph, 2014: Climatological characteristics of atmospheric rivers and their inland penetration over the western United States.*Mon. Wea. Rev.*, **142**, 905-921.

Lawson, J., and J. Horel 2014: Analysis of the 1 December 2011 Wasatch downslope windstorm. *Wea. Forecasting*. Accepted subject to revision.

Lareau, N., and J. Horel, 2014: Dynamically induced displacements of a persistent cold-air pool. *Boundary Layer Meteorology*. Accepted.

Ralph, F. M., and J. Horel (author 19 of 25 co-authors), 2014: A vision for future observations for western U.S. extreme precipitation and flooding. *Jour. of Contemporary Water Research & Education*, 153, 16-32.

Horel, J., R. Ziel, C. Galli, J. Pechmann, X. Dong, 2014: An evaluation of fire danger and behavior indices in the Great Lakes region calculated from station and gridded weather information. *International Journal of Wildland Fire*. 23, 202–214.